Push Enteroscopy

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12.1 History

For many years, the small bowel was considered to be a rare location for any pathology. This conviction, together with problems relating to construction of an endoscope dedicated to small bowel investigation, led endoscopists to be relatively uninterested in enteroscopy [1, 2]. This situation changed dramatically at the end of the twentieth century.

Three main lines of enteroscope development started in the 1970s: the ropeway type, the sonde type, and the push type. Ropeway enteroscopy was the first technique that allowed complete investigation of the small bowel [3, 4]. This method was based on insertion of the enteroscope over a Teflon tube (instead of a guide string) initially passed through the whole gastrointestinal tract up to the anus. This technique was time consuming and traumatic for the patient. In sonde enteroscopy, a balloon fixed on the endoscope tip was dragged by peristalsis through the small bowel; examination was performed during withdrawal of the instrument [5, 6]. Sonde enteroscopy was also a lengthy procedure, with no possibility of controlling insertion of the instrument. The disadvantages of both methods led to their abandonment. A push enteroscopy prototype was developed at the same time [7, 8]. The instrument was 162 cm in length. The tip was 1 cm in diameter and was inserted under fluoroscopy control. Intubation of 30 cm beyond the ligament of Treitz was presented in the first 250 cases.

Enteroscopy was initially a method with little application. Presentation of the idea that a colonoscope could be used instead of special, dedicated devices was a very important moment in the evolution of enteroscopy [9]. This approach opened the method for every endoscopy unit, and enteroscopy-controlled biopsies then gradually ousted blind biopsies obtained by means of a Rubin tube. Endoscopy allowed direct visual examination of the small bowel mucosa and biopsy sampling during one procedure, as well as repeated biopsies without removing the device. Technical developments continued, with the introduction in the 1990s of longer push enteroscopes (up to 250 cm) with

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video technology, allowing high-quality images from the oesophagus to the jejunum. For this reason, push enteroscopy was sometimes also called deep upper endoscopy or extended esophagogastroduodenoscopy.

12.2 Methods

The latest generation of push enteroscopes have a working length of 220–250 cm, external diameters of 10.5–11.7 mm, and channel diameters of 2.2–3.8 mm (Fig. 12.1). According to the published studies, a longer instrument does not always correlate with deeper insertion or higher diagnostic yield [10]. Compared with a standard endoscope, the bending section of a push enteroscope is longer, to allow increased angulation in all directions.

No specific preparation is administered before push enteroscopy. The patient fasts for 8 h before the investigation. Examination is carried out with the patient under conscious analgosedation; general anaesthesia is usually not required. Pulse, blood pressure, and arterial oxygen saturation should be monitored during the investigation.

Because of the flexibility of the enteroscope and the winding character of the small bowel, panenteroscopy is not possible. Advancement techniques similar to those used in colonoscopy (instrument progress by pushing, rotation, shortening, and straightening of the endoscope) have a limited effect inside the small bowel. The pushing force results in stretching of the small bowel, precluding further progress and causing patient discomfort. The duodenal tight curve from the duodenal bulb around the head of the pancreas, and its relatively fixed retroperitoneal posterior position also make transmission of propelling force difficult. The enteroscope is usually passed with the patient in the left lateral or semiprone position. If insertion is difficult, the patient may be moved to a supine, right lateral, or prone position. As in colonoscopy, abdominal pressure may be helpful.

Fig. 12.1 Olympus SIF-Q140 push enteroscope (Olympus Corporation, Tokyo, Japan). The working length is 250 cm; the instrument channel diameter is 2.8 mm

Some prospective studies have confirmed a significant increase in insertion depth by using a semi-rigid overtube [11, 12]. This tube has an outer diameter of 14.4 mm, a flexible segment at the distal end, and a radiopaque ring at the tip. The overtube reduces looping of the scope in the stomach and is placed before the pylorus or is inserted into the duodenum after the scope straightening inside the second or third duodenal section. However, published results are mixed, and overtubes are not always used because of the risk of complications. The use of a variable stiffness enteroscope has also been tested [13]. Sometimes the investigation can be performed under fluoroscopy control, in which the position of the enteroscope is checked and looping can be avoided. Use of these techniques usually enables examination of about 40–100 cm of the small intestine beyond the ligament of Treitz [14]. Mucosal examination should be carried out during insertion as well as retraction, because minor mucosal damage can mimic vascular or inflammatory lesions. Because a hypotonic small bowel precludes enteroscope insertion, it may be necessary to use antispasmodic drugs (glucagon or hyoscine i.v.) during the withdrawal phase only.

12.3 Advantages and Diagnostic Yield

The main advantages of push enteroscopy are the short investigation time (20–45 min); full control over the device, allowing repetitive pathology visualisation; and the possibility of biopsy sampling and therapy. Therapeutic options during push enteroscopy include thermocoagulation, treatment with haemoclips, polypectomy, dilation of stenosis, removal of foreign bodies, and placement of enteral feeding tubes [15]. Complications of the procedure (present in about 1 %) are more frequent than for standard upper endoscopy and are always associated with use of an overtube. These complications include mucosal stripping, pharyngeal tear, Mallory-Weiss tear, perforation, and pancreatitis after insertion of the overtube into the small bowel [16, 17].

The diagnostic yield of push enteroscopy ranges from 13 to 78 % and depends on the indication, being highest in patients with obscure gastrointestinal bleeding and abnormal findings localised in the distal duodenum or proximal jejunum (Figs. 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8, 12.9 and 12.10) [18–21]. Many studies and meta-analysis have proven the superiority of wireless capsule endoscopy over push enteroscopy for the diagnosis of small bowel pathology, with a 35–40 % incremental yield [22–27]. The published diagnostic yield of push enteroscopy in these patients is artificially increased by the identification of lesions overlooked during

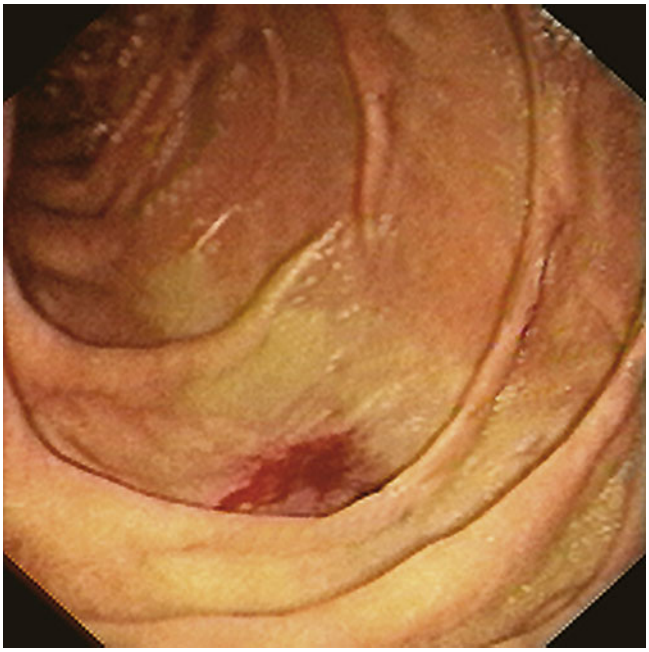

Fig. 12.2 Jejunal angiectasia with oozing bleeding in a patient with obscure overt gastrointestinal bleeding. The lesion was treated by means of bipolar electrocoagulation

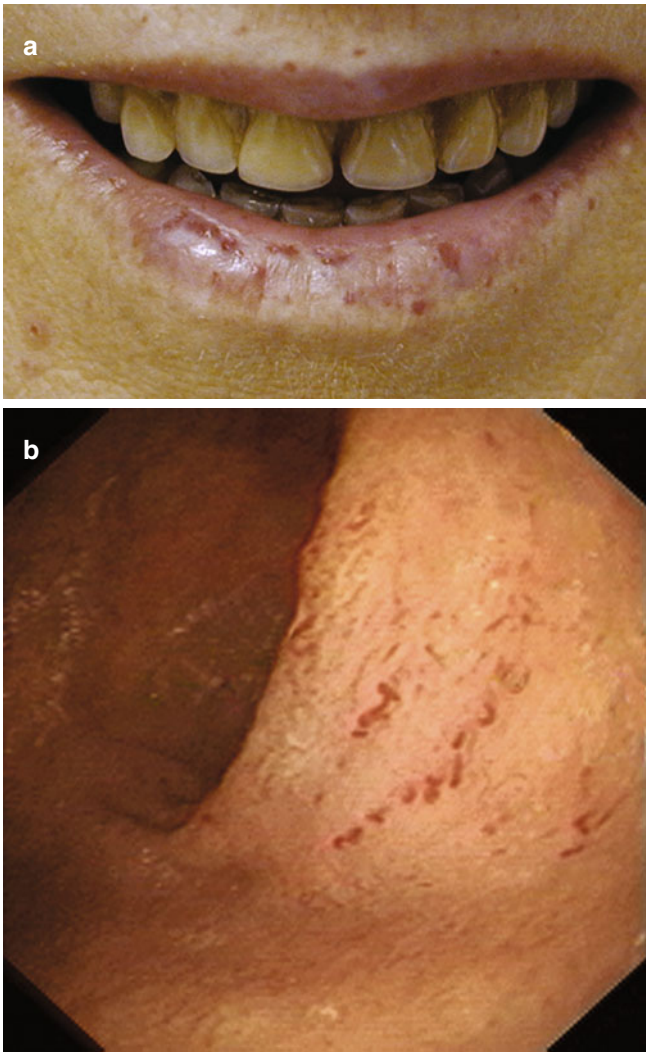

Fig. 12.3 Rendu-Osler-Weber syndrome (hereditary haemorrhagic telangiectasia, HHT). (**a**) Characteristic small red-to-violet telangiectatic lesions on the lips. (**b**) Patient was referred for push enteroscopy because of severe gastrointestinal bleeding. Typical multiple telangiectasias were diagnosed in the duodenum

initial gastroscopy [28]. The main limiting factor of push enteroscopy lies in the inability to perform panenteroscopy.

A very interesting experimental study by Appleyard et al. compared capsule endoscopy versus push enteroscopy in dogs [29]. Radiopaque coloured beads (3–6 mm) were surgically implanted into the small bowel of nine dogs (half placed within 100 cm of the pylorus, within reach of the push enteroscope), and all the animals underwent push and capsule enteroscopy. The sensitivity and specificity of push enteroscopy for detecting focal lesions within the entire small bowel were 37 and 97 %, respectively, compared with 64 and 92 % for capsule endoscopy. The higher sensitivity for capsule endoscopy was caused especially by the large number of beads found out of reach of the push enteroscope. On the other hand, the sensitivity of push enteroscopy within 100 cm of the pylorus (94 %) was superior to the sensitivity of capsule endoscopy (53 %), as capsule endoscopy missed lesions in the proximal duodenum because of the endoscopy-assisted delivery of the capsule endoscope inside the small bowel.

Although most endoscopy units (including our centre) indicate video capsule endoscopy followed by one of the deep enteroscopy methods in the majority of patients with small bowel pathology, push enteroscopy can be beneficial in some special situations, such as when a focal upper small intestinal lesion requires biopsy or endoscopy treatment and deep enteroscopy is unavailable [30]. Another role for push enteroscopy can be in patients with malabsorption. In most patients, coeliac disease can be diagnosed by means of duodenoscopy using a conventional gastroscope, carefully assessing the second part of the duodenum and taking biopsy specimens for histology. In some patients, however, the appearance of the duodenum may be abnormal but nonspecific; push enteroscopy is then a substantial tool for proper recognition, uncovering the typical mosaic pattern in the jejunum after getting past the duodenojejunal junction at the ligament of Treitz. If coeliac disease is suspected but both endoscopic and histologic duodenal findings are normal or nonspecific, we recommend enteroscopy to assess jejunal appearance and obtain several biopsy specimens of the jejunal mucosa [31]. According to another study, duodenal biopsies are sufficient to diagnose coeliac disease of Marsh III grade, but Marsh I or II lesions may be missed in some patients [32]. Push enteroscopy improves diagnostic yield in refractory sprue and makes it possible to take several jejunal biopsies for phenotyping of intraepithelial lymphocytes [31].

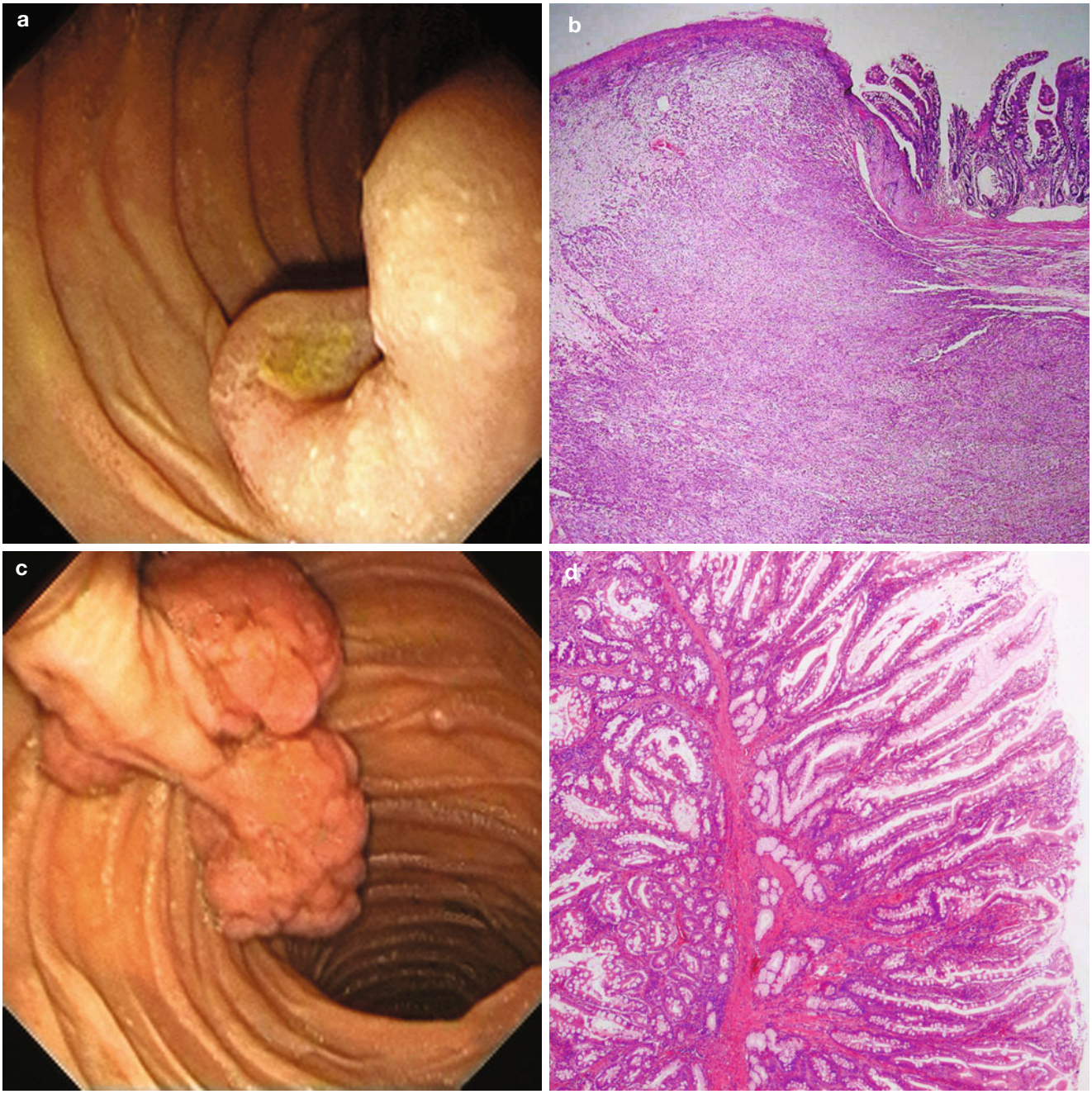

Fig. 12.4 Small bowel tumours. (**a**) Gastrointestinal stromal tumour. A large, polypoid, ulcerated, submucosal tumour in the proximal jejunum presented with occult bleeding. (**b**) Gastrointestinal stromal tumour. Histology showing a spindle-cell neoplasm localised within the submucosa, growing infiltratively into the mucosa with a superficial ulceration (haematoxylin-eosin [H&E], magnification 40×). (**c**) Peutz-Jeghers syndrome. Large stalked, lobated hamartoma in proximal jejunum. (**d**) Peutz-Jeghers syndrome. Histology of a hamartoma proving smooth-muscle bundles of the muscularis mucosae in the axial portion of the polyp, with overlying cystically dilated mucosal glands (H&E, magnification 100x)

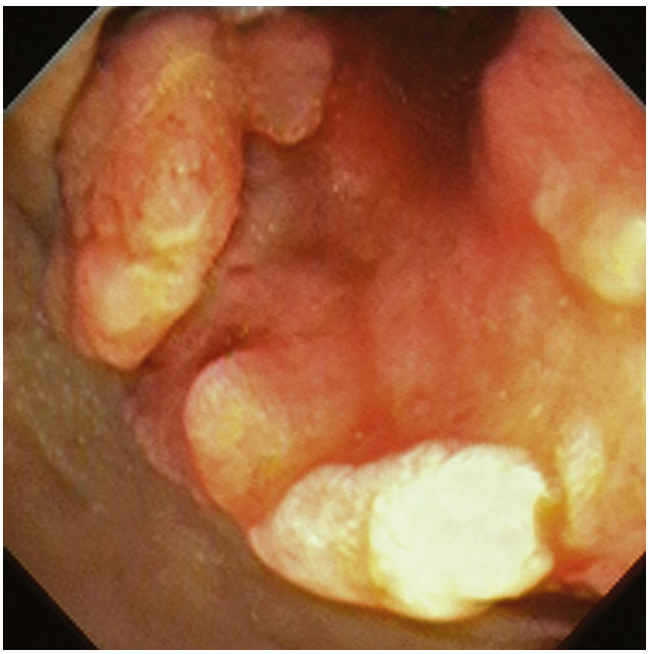

Fig. 12.5 Jejunal adenocarcinoma; tumour created circular stenosis with fragile polypoid margins

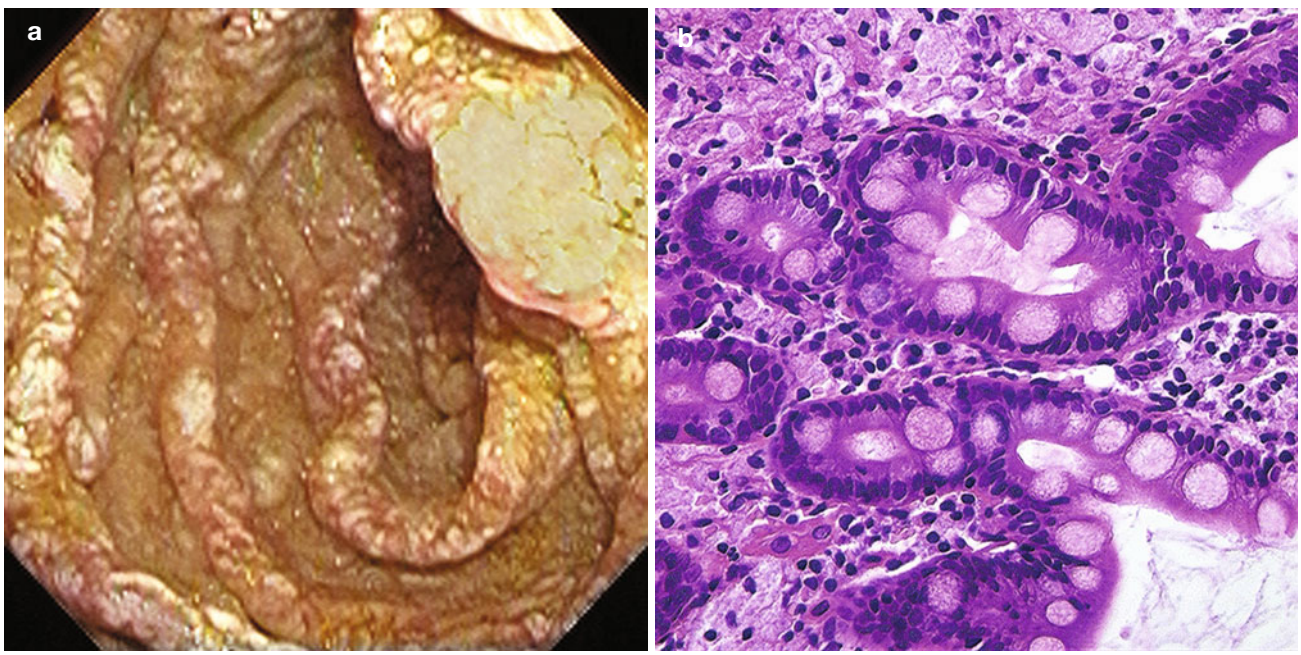

Fig. 12.6 Whipple's disease. (**a**) Oedema, focal erythema, and multiple lymphangiectasias in the jejunum. Characteristic whitish spots protrude a little above surrounding relief. Focally, the mucosa has a dusted-flour appearance. (**b**) Histology shows macrophages within the lamina propria mucosae, with strong positivity on periodic acid-Schiff (PAS) staining (magnification 100×)

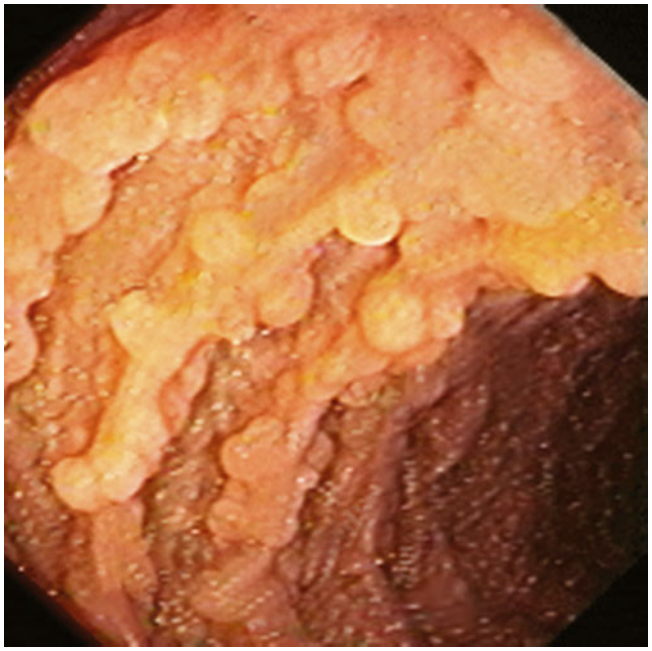

Fig. 12.7 Giardiasis of the jejunum. Lymphoid hyperplasia creates the nodular pattern of the mucosa

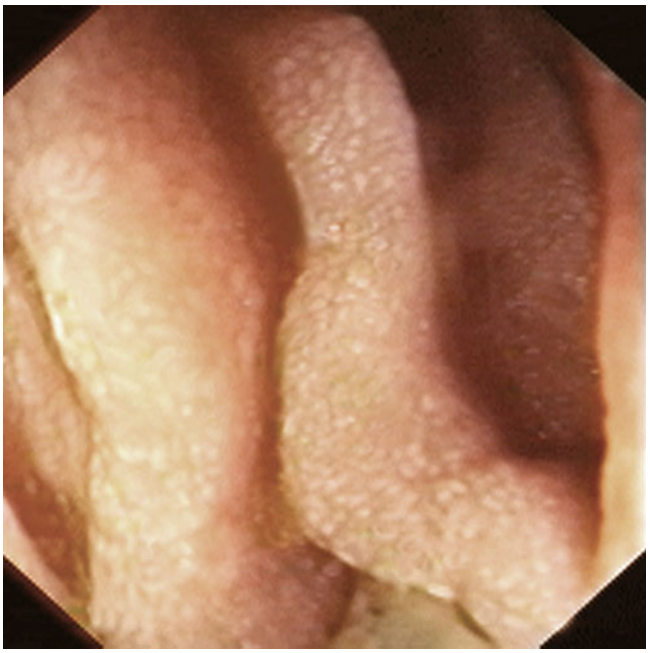

Fig. 12.9 Primary intestinal lymphangiectasia (Waldmann's disease). Jejunal folds are swollen and the mucosa of the jejunum has a fine, granular pattern. Multiple small, whitish granular spots are seen, which are caused by dilated lymphatic vessels

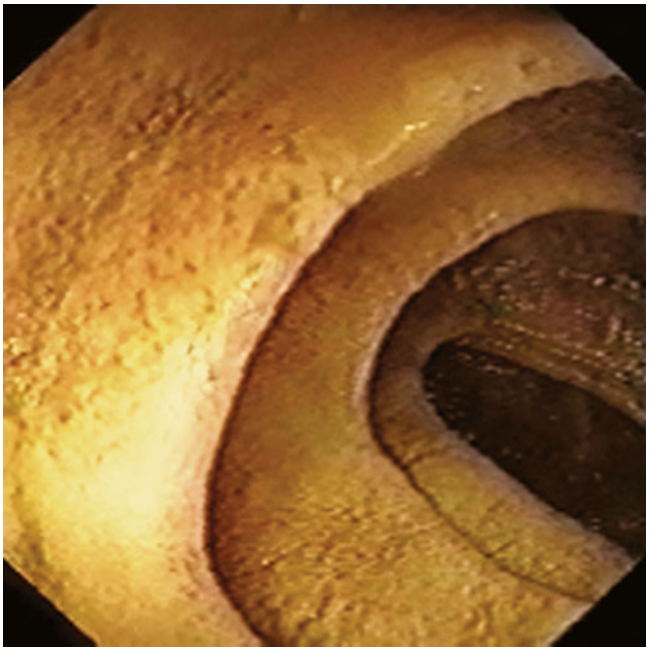

Fig. 12.8 Abetalipoproteinaemia. The proximal jejunum in this 29-year-old man was investigated because of chronic diarrhoea. Endoscopy showed swollen mucosa with grey-yellowish colour and fine granular pattern

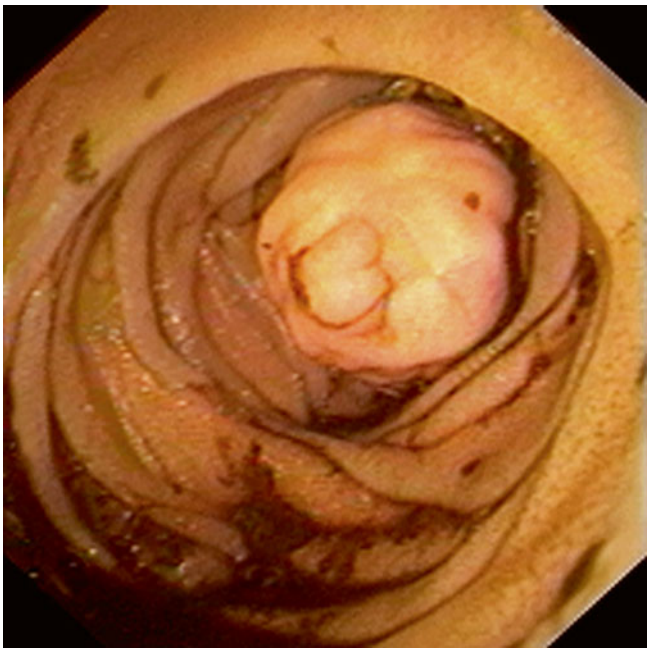

Fig. 12.10 Jejunal intussusception in a 79-year-old man with previous subtotal gastric resection because of adenocarcinoma. Ten centimetres distal to the anastomosis, a jejunal loop moves back into an efferent loop and causes mechanical ileus

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